

installation and user manual

ON GRID SOLAR PV INVERTER

SIRIO-ES 100 - 110



RIELLO ELETTRONICA  **riello** solar
tech

INTRODUCTION

Thank you so much for choosing SIRIO-ES 100k – 110k, the latest generation of grid-tied PV string inverters (hereinafter referred to as “inverter”) designed and developed by Riello Solartech.

Our company is specialised in the development and production of photovoltaic inverters. The solar inverters in this series are high-quality products, carefully designed and constructed with the aim of ensuring high performance.

This equipment can be used by any person, provided they **READ THIS MANUAL CAREFULLY AND THOROUGHLY**.

This user manual introduces the inverter in terms of its installation, electrical connections, operation, commissioning, maintenance and troubleshooting.

For information regarding use and to obtain maximum performance from your equipment, this manual should be stored carefully near the inverter and CONSULTED BEFORE OPERATION.

NOTE: some images contained in this document are for information purposes only and may not faithfully reproduce the parts of the product represented.

Application Model

Inverter PV on-grid

- **SIRIO-ES 100** PV three-phase inverter with eight MPPT inputs
- **SIRIO-ES 110** PV three-phase inverter with nine MPPT inputs

Intended Recipients






This user manual is intended for photovoltaic (PV) inverter operating personnel and qualified electrical technicians.

Note:

this user manual is subject to change without prior notice. The latest version of the user manual and additional information on the product are available on <http://www.riello-solartech.com>, and/or by consulting your dealer.

Symbol Conventions

The safety symbols used in this manual, which highlight potential safety risks and important safety information, are listed below:

Symbol	Description
 DANGER	Indicates an imminently hazardous situation which, if not correctly followed, will result in serious injury or death.
 WARNING	Indicates a potentially hazardous situation which, if not correctly followed, could result in serious injury or death.
 CAUTION	Indicates a potentially hazardous situation which, if not correctly followed, could result in moderate or minor injury.
 NOTICE	Indicates a potentially hazardous situation which, if not correctly followed, could result in equipment failure or property damage.
 NOTE	Calls attention to important information, best practices and tips: supplements the safety instructions to optimise your use of the PV inverter and reduce wastage of resources.


SAFETY PRECAUTIONS

Before using the product, please read these safety precautions in the User Manual carefully.

Personnel Safety


- The PV inverter must be installed, electrically connected, operated and maintained by a specially trained technician.
- The qualified technician must be familiar with the safety regulations concerning the electrical system, the working process of the PV power generation system and the standards of the local power grid.
- The technician must read through this User Manual carefully and master it before any operation.

PV Inverter Protection

 NOTICE	Upon receiving the PV inverter, please check whether it was damaged during transport. If it was, please contact your dealer immediately.
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- Do not tamper with any warning signs on the inverter's enclosure, because these signs contain important information on safe operation.
- Do not remove or damage the nameplate on the inverter's enclosure, because it contains important product information.

Installation Safety

 NOTICE	Please read the User Manual carefully before installing the PV inverter; warranty or liability will be voided if damage is caused by installation faults.
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- Ensure that there are no electrical connections around the PV inverter ports prior to installation.
- Adequate ventilation must be provided in the inverter's installation location. Mount the inverter in the vertical direction and ensure that no object is placed on the heat sink, as this may affect the cooling efficiency (for details, refer to the Installation chapter).

Electrical Connections

 DANGER	Before installing the inverter, check all electrical ports to ensure that there are no damages or short-circuits. Otherwise, personal injury and/or fire will occur.
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- Input terminals of the PV inverter apply only to input terminals of the PV string; do not connect any other DC source to the input terminals.
- Before connecting PV modules, ensure that their voltage is within the safe range; when exposed to any sunlight, PV modules can generate high voltage.
- All electrical connections must meet the electrical standards of the relevant country or region.
- Cables used for electrical connections must be properly secured, well-insulated and made to the appropriate specification.

Operation and Commissioning

 DANGER	While the inverter operates, high voltage can lead to an electrical shock hazard and even cause personal injury. Therefore, operate the PV inverter strictly according to the safety precautions in this User Manual.
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- Unless permission has been obtained from the power company of the country/region, the grid-tied PV inverter cannot start generating power.
- Follow the procedures for commissioning described in the User Manual when commissioning the PV inverter.
- When the PV inverter is operating, do not touch the surface of any other parts except for the DC switch; its constituent parts will be extremely hot and can cause burns.

Maintenance

 DANGER	Power OFF all electrical terminals before performing inverter maintenance; strictly comply with the safety precautions stated in this document when operating the inverter.
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- For personal safety, maintenance personnel must wear appropriate personal protective equipment (such as insulation gloves and protective shoes) for inverter maintenance operations.
- Place temporary warning signs or erect fences to prevent unauthorised access to the maintenance site.
- Strictly follow the maintenance procedures specified in the User Manual.
- Check the relevant safety and performance of the inverter; rectify any faults which may compromise the safe operation of the inverter before restarting it.

Additional Information




 NOTICE	To avoid any other unforeseeable risk, contact the dealer immediately if any safety issue emerges during operation.
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PROTECTING THE ENVIRONMENT

Our company has devoted extensive resources to the analysis of environmental aspects in the development of our products. All our products pursue the objectives set out in the environmental management system policy, developed by our company in accordance with current legislation.

This product does not contain hazardous materials such as CFCs, HCFCs or asbestos.

Product packaging is made from RECYCLED MATERIALS. The disposal of individual components must be performed in accordance with current legislation in the country where the product is used. Refer to the following table for material identification:

DESCRIPTION	MATERIAL	
Packaging box	Corrugated cardboard (PAP)	 20 PAP
Protective bag	High-density polyethylene (HDPE)	 02 PE-HD
Foam	Low-density polyethylene (LDPE)	 04 PE-LD

LIMITED GUARANTEE

The equipment you have purchased has been constructed according to the most modern techniques and was rigorously tested before leaving the factory.

During the guarantee period, the manufacturer shall repair or replace parts that prove defective, provided that such defects have not been caused by incompetence or negligence of the buyer, fortuitous events or force majeure (lightning, fire, flood, etc.), incorrect or inadequate installation other than as stated in the manual, unsuitable transport or delivery, opening of the unit by unqualified personnel or breaking of the closure seal, modification, testing or unauthorised repair, use or application beyond the limits defined by the manual, or application beyond those defined by safety standards (VDE, UL, etc.).

It is the responsibility of the person applying for technical assistance from Customer Service to provide detailed information about the detected failure or malfunction.

The repair and/or replacement of parts or the device shall be implemented at the discretion of the supplier.

Any repair under guarantee will be performed by the manufacturer or an authorised service centre. Equipment must arrive at the risk and expense of the customer in its original packaging so as not to cause further damage.

If repairs must be performed directly at the customer's premises, the customer shall be charged for expenses and hours of travel, while the costs for labour and parts shall be borne by the manufacturer. This guarantee does not in any case cover the replacement of equipment or compensation for any direct or indirect costs or claims for damage caused by device malfunction.

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PRESENTATION



PRODUCT PRESENTATION

This chapter introduces the inverter and describes its functional model, network application, appearance, dimensions and working process, etc.

Functional Model

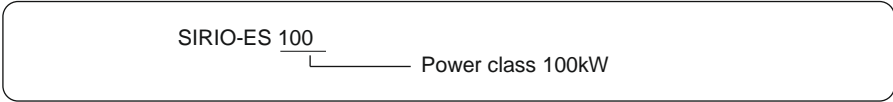
Function

This series consists of a three-phase grid-tied PV string inverter (transformerless) which converts the DC power generated by PV strings into AC power and feeds the power into the power grid.

 WARNING	The inverter is transformerless: if the positive/negative terminal of PV strings has to be connected to ground (i.e. thin-film module), it is mandatory to install an external isolation transformer to ensure proper operation.
 WARNING	Do not connect PV modules in parallel to several PV inverters for operation.

Model Description

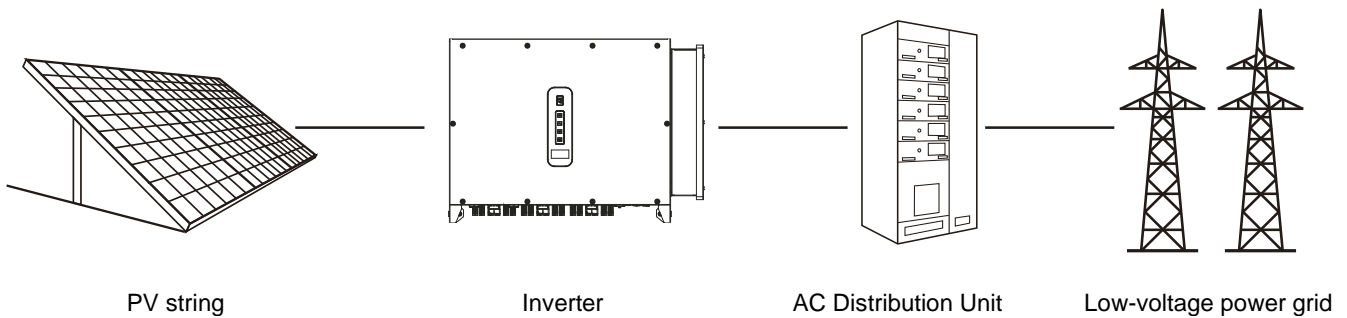
The number in the model name indicates the power class of the inverter, for example:



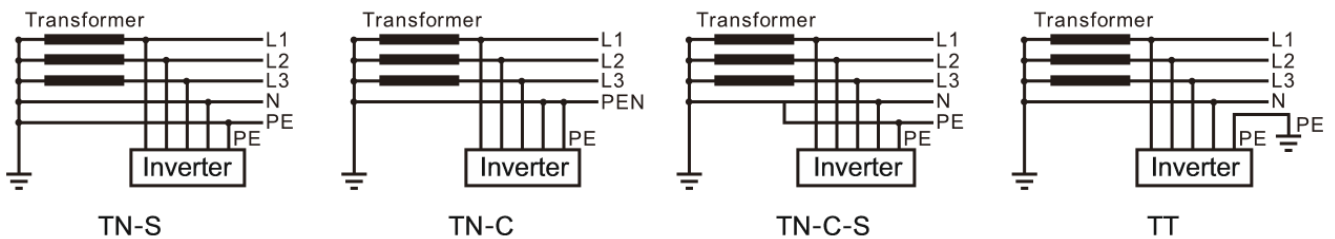
Network Application

Grid-tied PV Power Systems

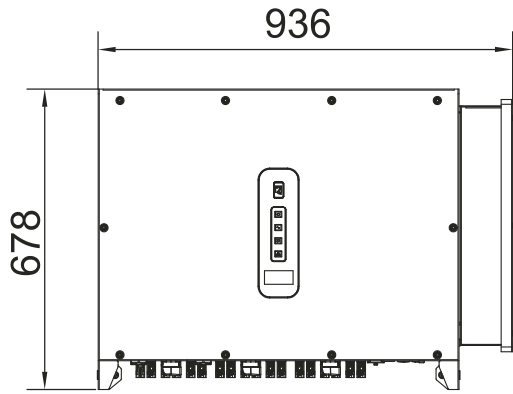
The series include grid-tied PV power systems for industrial/commercial rooftops, light complementary power generation systems, and large ground-based power stations. Typically, a grid-tied PV power system consists of PV modules, grid-tied inverters, AC distribution units and a low-voltage power grid, as shown in the figure below:



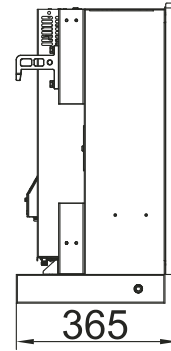
These series inverters support TN-S, TN-C, TN-C-S, and TT power grids as shown in the figure below:



Outline and dimensions



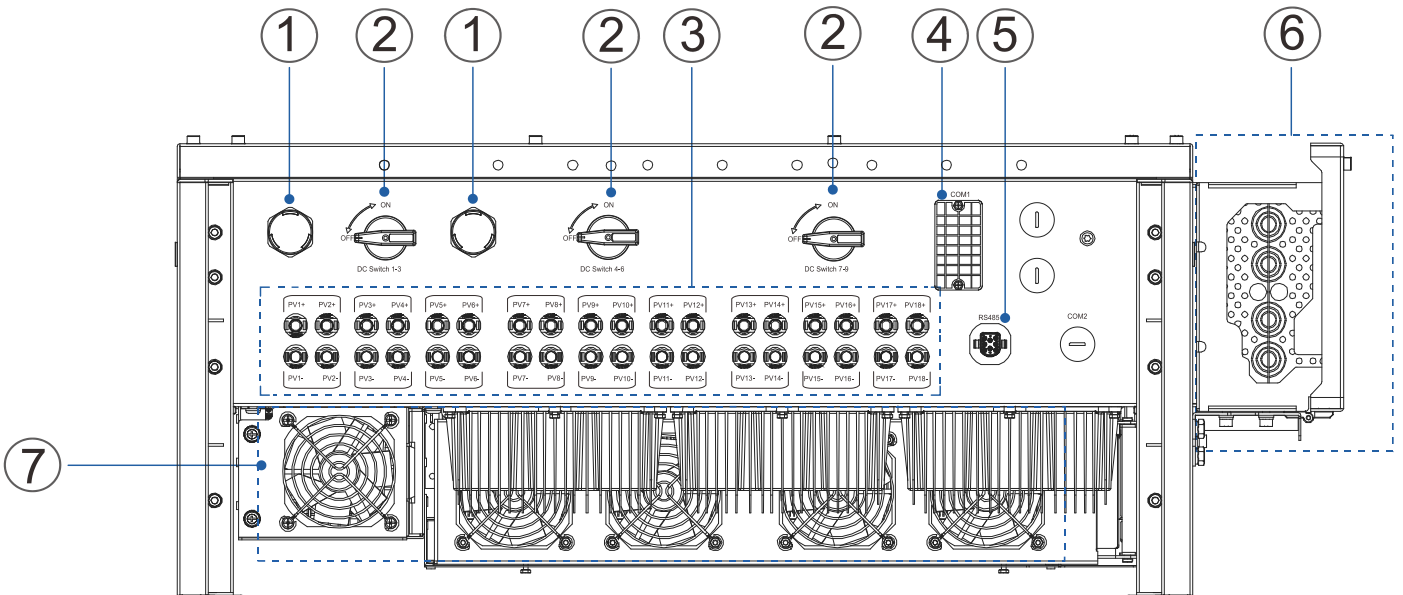
SIRIO-ES 100 – 110
Front view



SIRIO-ES 100 – 110
Side view

unit: mm

Connections Area



1. Vent valve
2. PV switches
3. MPPT inputs
4. DB9 Communications interface
5. RS485 port
6. AC output connection box
7. Cooling fan

Operating principles

Basic operating principles

SIRIO-ES 100 and 110 can receive inputs from 16 or 18 strings of PV panels, respectively. Then, the inputs are grouped into eight independent MPPT routes inside the inverter SIRIO-ES 100, or nine independent MPPT routes inside the inverter SIRIO-ES 110, to track the maximum power point of the PV panels. The MPPT power is then converted into DC bus and the DC power is converted to AC power through an inverter circuit. Lastly, the AC power is fed into the power grid. Surge protection and EMI filter are supported on both the DC and AC sides to reduce electromagnetic interference.

Operating Modes



The operating modes of the inverter are described below: stand-by, operation, and shutdown.

The table below shows the conditions for the inverter to switch between operating modes.

Mode	Description
Stand-by	The PV inverter enters the stand-by mode when: <ul style="list-style-type: none">• The input voltage of the PV string can enable the auxiliary power supply to run but cannot meet the inverter operation requirements.• The input voltage of the PV string can meet the inverter start-up requirements but cannot meet its minimum power requirements.
Operation	When the PV inverter is grid-tied and generates electricity, it tracks the maximum power point to maximise the PV string output. It converts DC power from PV strings into AC power and feeds the power into the power grid. The PV inverter will enter the shutdown mode if a fault is detected or a shutdown command is given.
Shutdown	The PV inverter switches from stand-by or operating mode to shutdown mode if a fault is detected or a shutdown command is given. The inverter switches from shutdown mode to stand-by mode if a start-up command is given or when it detects that a fault has been rectified.

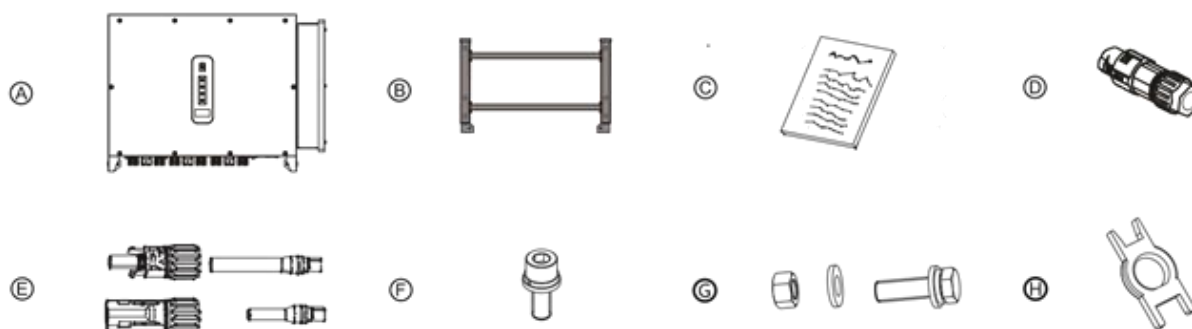
INSTALLATION

PRELIMINARY CHECKS


 DANGER	Do not install the inverter on flammable building materials or in an area where flammable or explosive materials are stored.
 CAUTION	Do not install the inverter in a place where personnel are likely to come into contact with its enclosure and heat sinks, to avoid electrical shock or burns.

Checking the packaging contents

- Upon receiving the inverter, check that the packaging materials are intact.
- After unpacking, check that the deliverables are complete, intact and consistent with your order list.
- Examine the PV inverter and its fittings for any damage such as scraps and cracks.

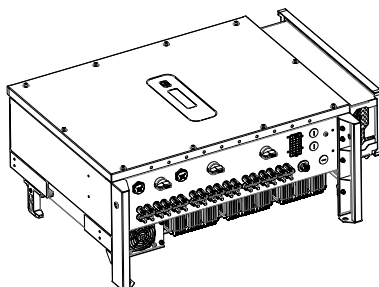




ARTICOLO	DESCRIZIONE
A	PV Inverter
B	Rear panel
C	Manuals
D	RS-485 connector
E	DC terminal connector group
F	M8 screws
G	M12 screw group (including screws and nuts) * 4 (reserved for tightening the rear panel)
H	Removal tool for DC connectors

 NOTICE	If any of the damage mentioned above is found, contact the dealer immediately.
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Moving the inverter

After checking the outer packaging, move the PV inverter to the designated installation position horizontally, as shown in the figure below.







 CAUTION	<p>The inverter is relatively heavy! To prevent device damage and personal injury, arrange four people to move the inverter and handle with care.</p>
 CAUTION	<p>Do not place the PV inverter with its wiring terminals in contact with the floor, because the power ports and signal ports at the bottom of the device are not designed to bear the weight of the inverter. When placing the inverter on the floor horizontally, place foam or paper under it to protect its enclosure.</p>

Identifying the PV Inverter

Nameplate

After removing the PV inverter from its packaging box, identify it by reading its nameplate affixed to the side of the inverter. The nameplate contains important product information: model, communication/technical specifications and compliance symbols.

	<p>Risk of electric shock The device contains high voltages, both alternating and direct current, and high leakage currents may be generated during operation. To avoid the risk of electric shock during maintenance or installation, make sure that all DC and AC connection terminals are disconnected. First connect the grounding wire to ground and disconnect it last during maintenance. Check for the proper phases and neutral connection. If the unit is used without following the specifications of the manufacturer, the protection provided by the equipment may be impaired. Disconnect the inverter from the grid and from the photovoltaic generator before cleaning the photovoltaic modules: an unexpected capacitive current from the surface of the modules may surprise operators, causing them to fall off the roof.</p>
 10 mins	<p>Handling the photovoltaic inverter The photovoltaic inverter must only be handled by qualified service personnel. When the photovoltaic generator is exposed to sufficiently intense light, it generates DC voltage, and when connected to the device, it charges the bulk capacitor. After having disconnected the photovoltaic inverter from the grid and the photovoltaic generator, an electric charge may remain in the bulk capacitor. Please wait at least 10 minutes after disconnecting the device from the grid before handling it.</p>
	<p>Exclusively for the grid and PV modules The PV inverter is designed for the sole purpose of converting energy from PV modules and injecting it into the grid. This inverter is not designed to be powered by sources of primary energy other than PV modules or to be connected to different loads other than the public grid.</p>
	<p>Hot surfaces Although it has been designed in accordance with international safety standards, the photovoltaic inverter may become hot during operation.</p>

Installation Requirements

These apply to support-mounted installation, as described below in detail.

Determining the Installation Position

Basic Requirements

- The inverter is protected to IP66 and can be installed indoors or outdoors.
- The mounting location must be inaccessible to unrelated personnel since the bracket and heat sinks are extremely hot during operation.
- Do not install the PV inverter in areas containing highly flammable materials or gases.
- To ensure optimum operation and long operation life, the ambient temperature must be below 50° C.
- The PV inverter must be mounted in a well-ventilated environment to ensure good heat dissipation.
- To ensure long operation life, the storage of the inverter must not be exposed to direct sunlight, rain, or snow. It is recommended that the inverter be mounted in a sheltered place.
- The carrier where the inverter is mounted must be fire-proof. Do not mount the inverter on flammable building materials.
- Do not install the inverter in a rest area since it will cause noise during operation.
- The installation height should be reasonable and make sure it is easy to operate and view the display.
- Product label and warning symbols shall be clear to read after installation.
- Please avoid direct sunlight, rain exposure, snow lay-up.

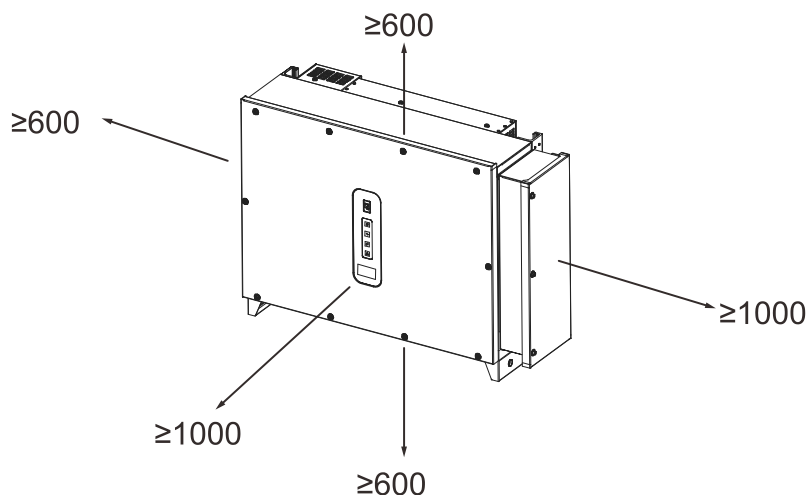
Installation Environment Requirements



NOTICE

An improper installation of the inverter may cause malfunctioning or performance loss.

- Install the inverter upright. Do not install the inverter upside down.
- It is recommended that the inverter be installed at eye level to facilitate operation and maintenance.
- Reserve enough clearance around the inverter to ensure sufficient space for installation and heat dissipation, as shown in the picture below.




Installation on the wall

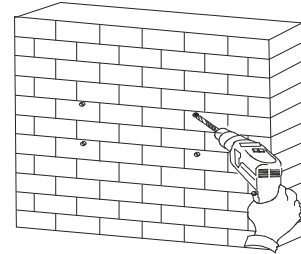
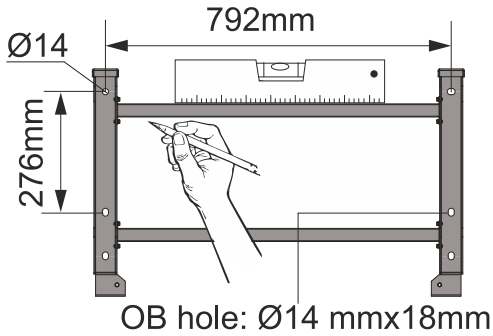
Support-mounting the inverter is recommended.

Step 1 Remove the rear panel from the packaging box.

Step 2 Hold the wall brackets horizontally using a level. Mark the holes position on the wall.

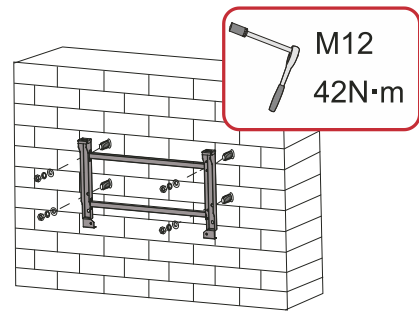
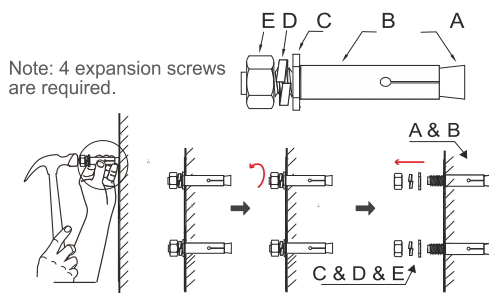
Step 3 Drill the holes.

 DANGER	Before drilling holes, check whether there are electrical pipes or other pipes buried in the walls to avoid risks.
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Ø: 14mm; Depth: 65mm


Step 4 Secure the mounting bracket on the wall using M12 expansion screws. Stainless steel pressure-burst expansion bolts are recommended in wall-mounted installation.

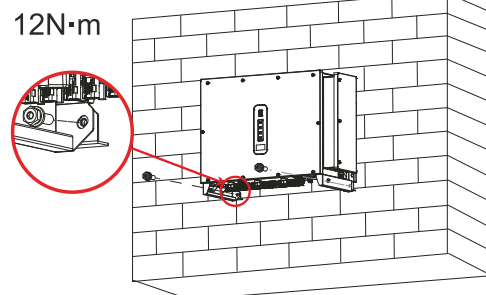
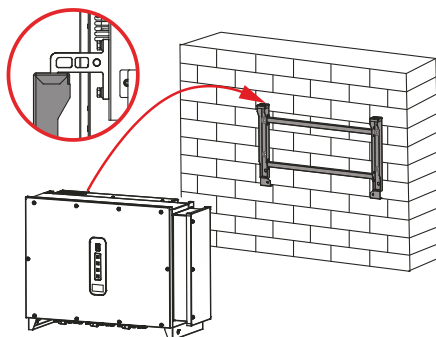


Step 5 Lift the inverter from the bottom and place it on the bracket.

 NOTE	AC output connection box can't be stressed in the process of lifting.
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Step 6 Secure the inverter to the bracket using the included M8 screws.

 DANGER	Ensure that the load-bearing capacity of the wall is greater than 10KN/m ² .
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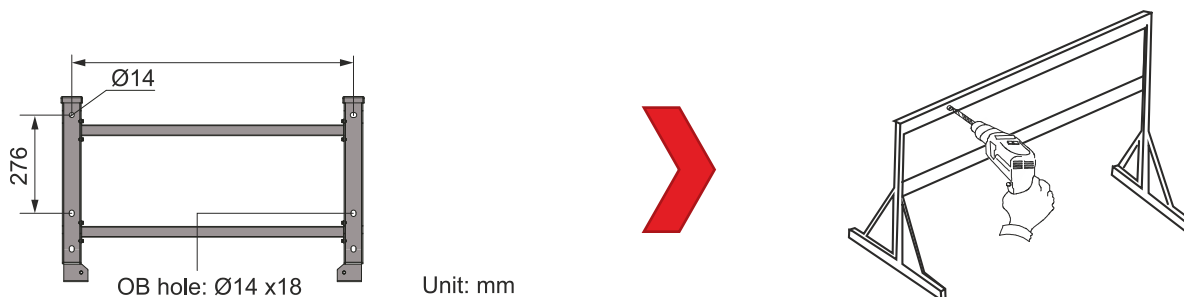


Installation on a support bracket

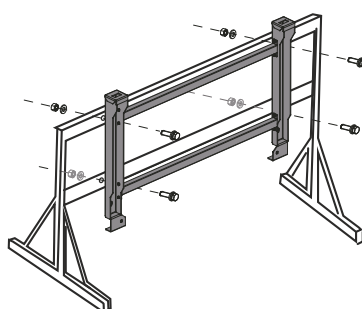
Step 1 Remove the rear panel from the packaging box. Prepare the support bracket (not included).

Step 2 Mark the holes position on the support bracket.

Step 3 Drill the holes.



Step 4 Secure the mounting bracket with bolts from delivery accessories (4 M12 screws and nuts, 42 N·m).



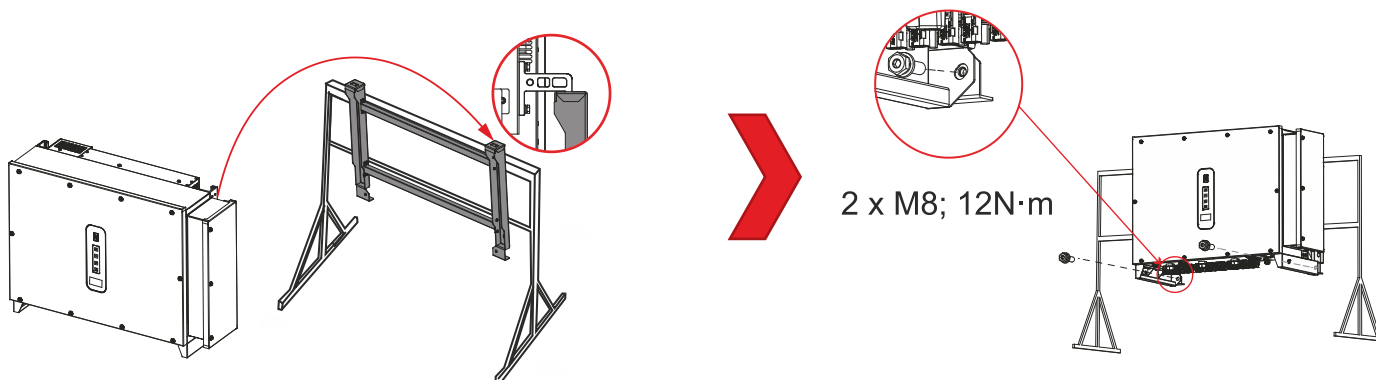
Step 5 Lift the inverter from the bottom.



NOTE

AC output connection box can't be stressed in the process of lifting.

Step 6 Secure the inverter on the bracket using the included M8 screw.



Installation self-check



Step 1 Ensure that the inverter is well fixed.

Step 2 Ensure that the inverter is locked on the support with an anti-theft lock installed or with the included screws.

ELECTRICAL INSTALLATION

Preliminary operations




- It is advisable to install a circuit breaker on the AC side with rated current higher than 250A.
- Turn the DC switch off.
- Open the AC switch downstream of the inverter.
- The inverter has a residual current protection function with square matrixes internally installed, it is possible to set the leakage current protection value in case it is needed. This helps the inverter to perform as it should. The residual current setting can't be less than 1110 mA for the SIRIO-ES 100 model and 1230 mA for the SIRIO-ES 110 model.

 DANGER	Before performing any electrical connections, ensure that both DC and AC switches are OFF. Otherwise, fatal injury can occur due to the high voltage generated from AC and DC cables.
 CAUTION	If it is needed, grounding the PV strings needs below prerequisites. <ul style="list-style-type: none"> - Ensure that the neutral wire of the isolation transformer is disconnected from the PGND cable. - Install one isolation transformer for every PV inverter, do not install a single isolation transformer for multiple inverters. Otherwise, circulating current generated by the inverter will lead to operation failure. - Select "Isolation SET" in the APP and then "Input Grounded", "With TF".

Connecting Protection Ground (PGND) cables

Preparation

The ground cable and OT terminals have to be prepared. It is mandatory to use OT terminals with a hole for M8 screws. For the PGND cable, it is suggested to install one that has at least double the cross section of the neutral and live wires. This instruction applies only if the neutral/live wires are of the same materials as the ground wire.

 NOTICE	Connecting External Protection Ground (PGND) Cables cannot substitute the connection of the PE cable from the AC power cables. Ensure that both connections are grounding well. Otherwise, warranty will be void if damage is caused by electrical connections fault.
 NOTE	Proper ground for the inverter helps to counter the impact of surge voltage and improve EMI performance. Connect the PGND cable before connecting the AC and DC power cables and the communication cables.
 NOTE	It is recommended that the ground cable is connected to a nearby ground position. For a system with multiple inverters connected in parallel, connect the inverters to the same ground point to ensure equipotential connections.

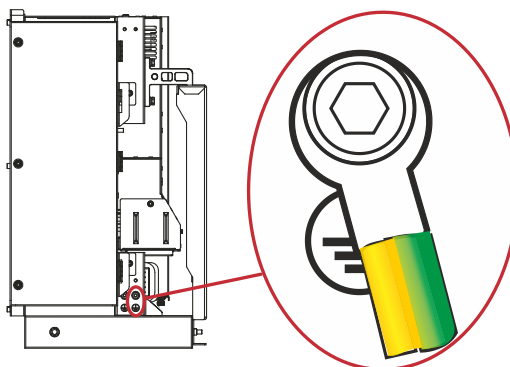
Wiring procedures

Step 1 Remove an appropriate length of the insulation layer from the PGND cable using a wire stripper.

Step 2 Insert the exposed core wires into the crimping areas of the OT terminal and crimp them using hydraulic crimper.



Step 3 Remove the grounding screw from the inverter grounding point.

Step 4 Secure the PGND cable (done in steps 1 and 2) using the ground screw and tighten the screw to a torque of 1.2 Nm using a socket wrench.



Connecting the AC Output cables

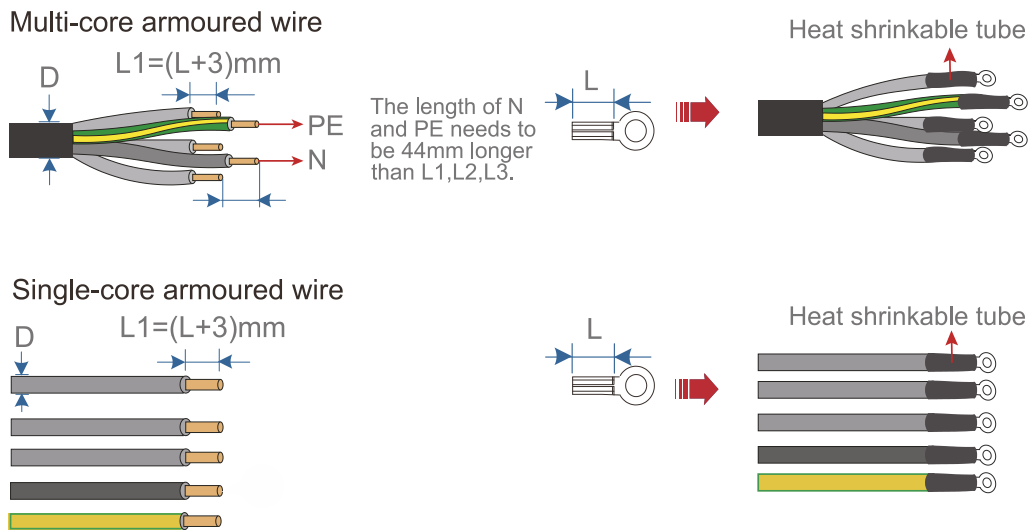
Preparation

 NOTICE	Prepare multi-stranded wire, crimping terminals and a proper crimping tool before AC wiring.
 NOTE	The inverter requires M12 OT terminals (not supplied).

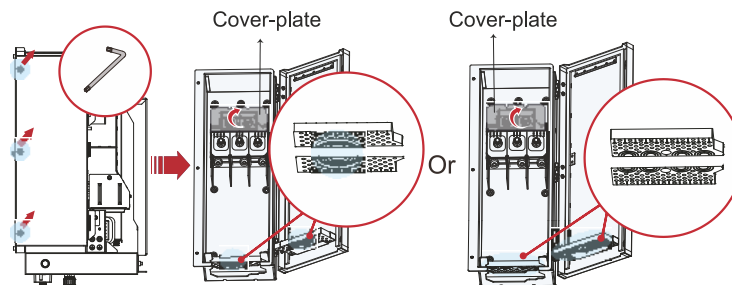
It is recommended to use outdoor multi-core copper wires. The following table describes the AC cable requirements.

Cable	Nr. Of wires	Type	Cross-section (mm ²)	Diameter (mm)
Outdoor multi-core AC cable	Outdoor triple-core cable (L1, L2, L3)	Copper wire	70 ~ 240	24 ~ 69
	Outdoor four-core cable (L1, L2, L3, PE) Outdoor five-core cable (L1, L2, L3, PE, N)	Aluminium wire	95 ~ 240	
Outdoor single-core AC cables	Five single-core outdoor cables	Copper wire	70 ~ 240	14 ~ 32
		Aluminium wire	95 ~ 240	

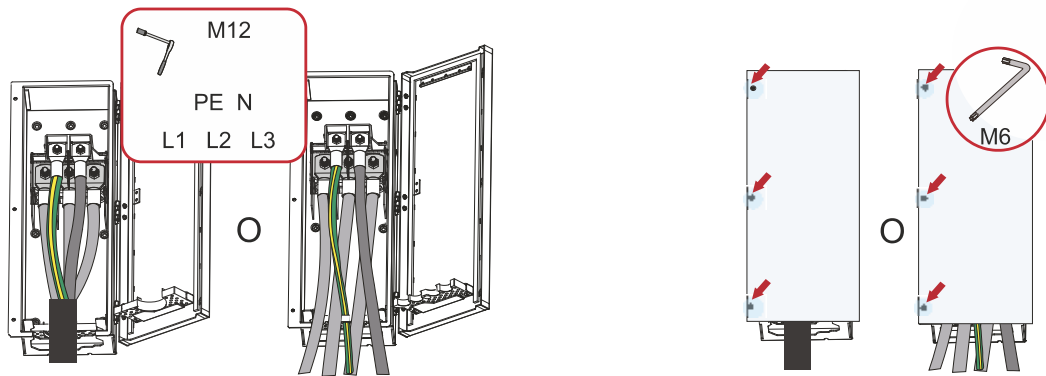
Step 1 Make the necessary wires for inverter connection as shown in the next picture. Neutral and PE cables must be 44mm longer than live wires. After crimping OT terminals on the wires, insulate the connection with heat shrink tubing.



Step 2 Loosen the screws to open the locking-cap and cover plate.



Step 3 Tighten the screws with a torque of 20-30 N-m. Reinstall the locking-cap and the cover plate, using a torque of 3~4 N-m.

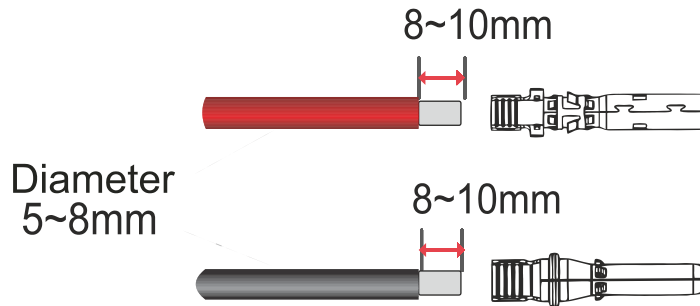


Connecting the PV strings

DANGER	The PV strings connection must comply with the following prerequisites; otherwise, an electric shock may occur.
DANGER	PV modules generate electrical energy when exposed to sunlight and can create an electric shock hazard. Therefore, when connecting the PV modules, shield them with opaque cloth.
DANGER	Before connecting the DC input power cables, ensure that the voltage on the DC side is within the safe range and that the DC SWITCH on the inverters is OFF. Otherwise, high voltage may result in electrical shock.
DANGER	When the inverter is grid-tied, it is not allowed to maintain DC input power cables, such as those used to connect or disconnect a string or a module in a string. Only after the inverter enters in shutdown mode can maintenance on the DC input power cables be performed.
WARNING	If grounding the PV strings, it is mandatory to install an isolation transformer on the AC side of the inverter following the subsequent prerequisites: <ul style="list-style-type: none"> • Ensure that the neutral cable of the isolation transformer is not connected to the grounding cable. • Install an isolation transformer per inverter. Do not connect multiple inverters to a single isolation transformer. • Select "Isolation SET" in the App and then "Input Grounded", "With TF"
WARNING	PV modules connected in series in each PV string must have the same specifications.
WARNING	The maximum open-circuit voltage of each PV string must be always lower than or equal to its permitted range.
WARNING	The maximum short-circuit current of each PV string must be always lower than or equal to its permitted range.
WARNING	The positive and negative terminals of PV modules must be connected to the positive and negative DC input terminals of the inverter, respectively.
WARNING	During the installation of PV strings and the inverter, the positive or negative terminals of PV strings cannot be short-circuited.

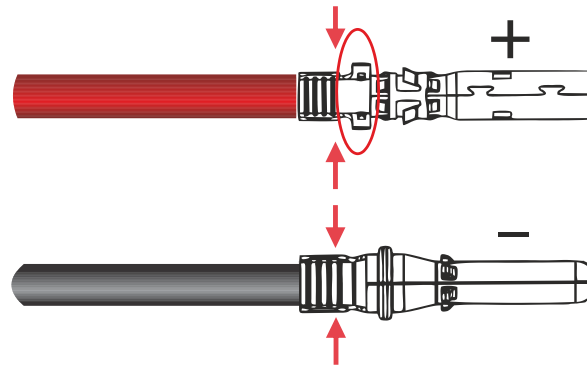
Cable preparation

Step 1 Remove an adequate length of insulating layer from the positive and negative power cables using a wire stripper, as shown in below image.

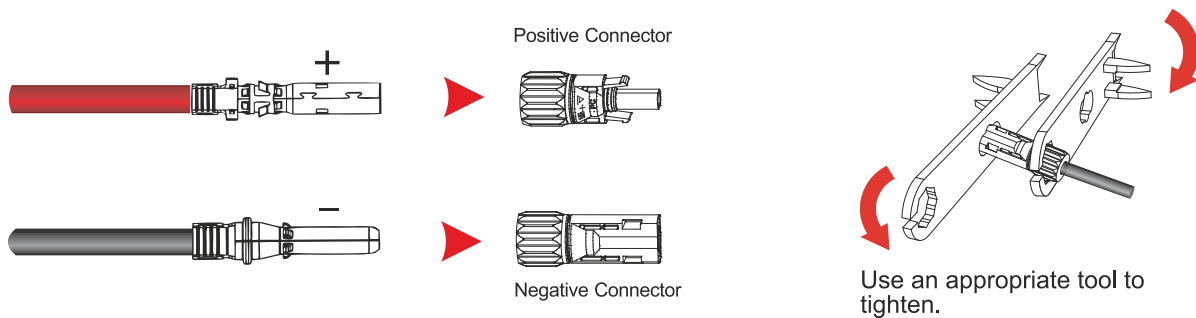


Step 2 Insert the exposed areas of the positive and negative cables into the metal terminals of the positive and negative connectors respectively and crimp them using a crimping tool.

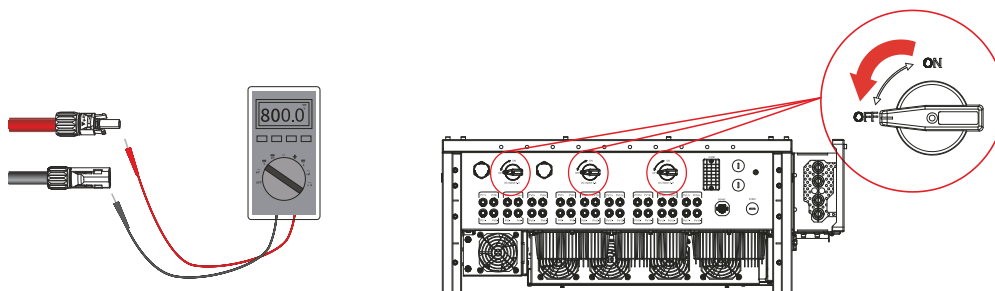
Use crimping tool on the zone indicated by the arrows to stitch. Do not crimp the zone circled in red.



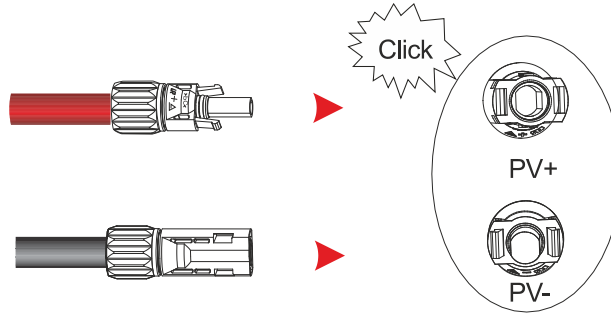
Step 3 Insert the crimped positive and negative cables into the corresponding positive and negative connectors. Tighten the waterproof nuts on each connector with an appropriate tool.



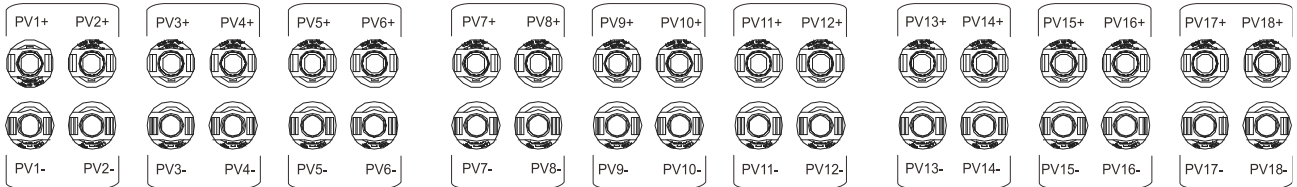
Step 4 Test string voltage and confirm polarity. Ensure that all DC switches are OFF before step 5.



Step 5 Insert positive and negative connector in PV+/PV- port respectively until a “click” sound is heard.



NOTICE To ensure maximum performance, connect the PV strings to the PV ports as shown in the below table.



The picture shows the SIRIO-ES 110 MPPT inputs as reference. The following table shows how to connect the PV strings to inverter inputs to maximize performance.

Model: SIRIO-ES 100

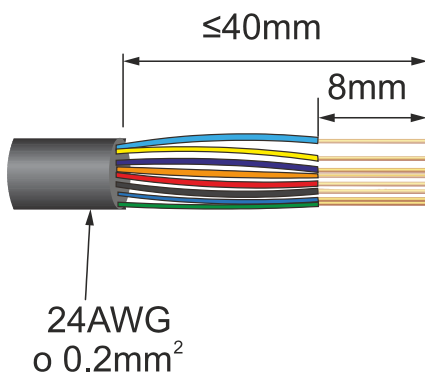
Strings	Input															
	PV1	PV2	PV3	PV4	PV5	PV6	PV7	PV8	PV9	PV10	PV11	PV12	PV13	PV14	PV15	PV16
1	●															
2	●		●													
3	●		●		●											
4	●		●		●		●									
5	●		●		●		●		●							
6	●		●		●		●		●		●					
7	●		●		●		●		●		●		●			
8	●		●		●		●		●		●		●		●	
9	●	●	●		●		●		●		●		●		●	
10	●	●	●	●	●		●		●		●		●		●	
11	●	●	●	●	●	●	●		●		●		●		●	
12	●	●	●	●	●	●	●	●	●		●		●		●	
13	●	●	●	●	●	●	●	●	●	●		●		●		●
14	●	●	●	●	●	●	●	●	●	●	●		●		●	
15	●	●	●	●	●	●	●	●	●	●	●	●		●		●
16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Model: SIRIO-ES 110

Strings	Input																	
	PV 1	PV 2	PV 3	PV 4	PV 5	PV 6	PV 7	PV 8	PV 9	PV 10	PV 11	PV 12	PV 13	PV 14	PV 15	PV 16	PV 17	PV 18
1	●																	
2	●		●															
3	●		●		●													
4	●		●		●		●											
5	●		●		●		●		●									
6	●		●		●		●		●		●							
7	●		●		●		●		●		●		●					
8	●		●		●		●		●		●		●		●			
9	●		●		●		●		●		●		●		●		●	
10	●	●	●		●		●		●		●		●		●		●	
11	●	●	●	●	●		●		●		●		●		●		●	
12	●	●	●	●	●	●	●		●		●		●		●		●	
13	●	●	●	●	●	●	●	●	●		●		●		●		●	
14	●	●	●	●	●	●	●	●	●	●		●		●		●		●
15	●	●	●	●	●	●	●	●	●	●	●		●		●		●	
16	●	●	●	●	●	●	●	●	●	●	●	●		●		●		●
17	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	
18	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

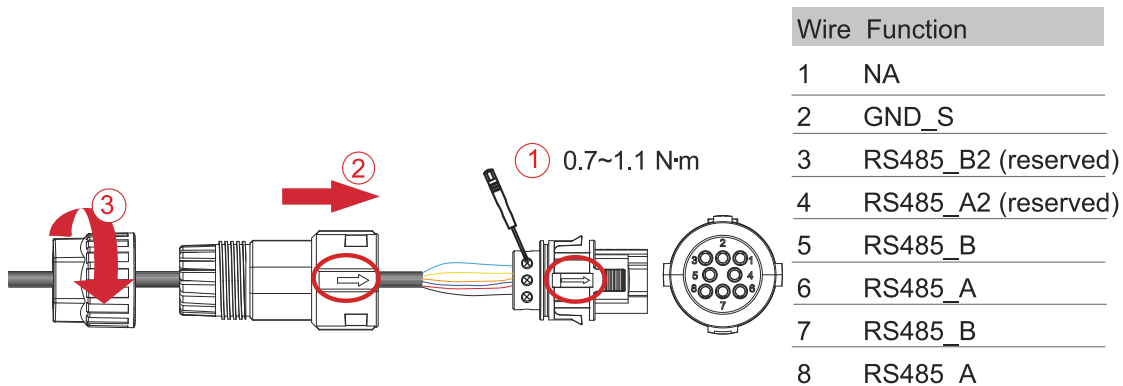
RS485 Communication cables connection

Step 1 Make a wire as shown in the image.

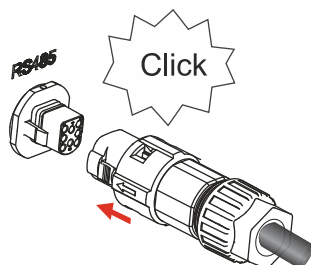


Step 2 Insert the cable through nut and connector housing.

Step 3 Insert the wires in the connector and tighten the screws to ensure proper connection, verify that each screw doesn't exceed the surface. Push the connector housing over the connector lining up the arrows. Tighten the nut to avoid loosening.

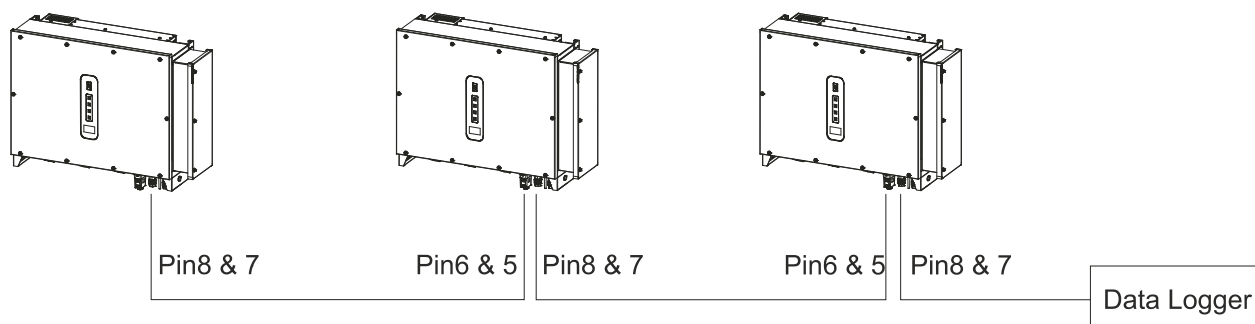


Step 4 Remove the dust-proof cap and insert the connector in the RS485 port until a "click" is heard.



RS485 Communication mode with multiple inverters

To connect multiple inverters on a single RS485 bus, connect signals from the first RS485 cable from data logger to pin 8 and 7 of the first inverter. In case there is more than one inverter, connect pin 6 and 5 of the first inverter to pin 8 and 7 of the second one, as shown in the image. This sequence applies to subsequent inverters.



Modbus address setting

It is mandatory to set the Modbus address in case there are multiple inverters connected to a single RS485 line.

Step 1 Scan the QR code to download the APP.

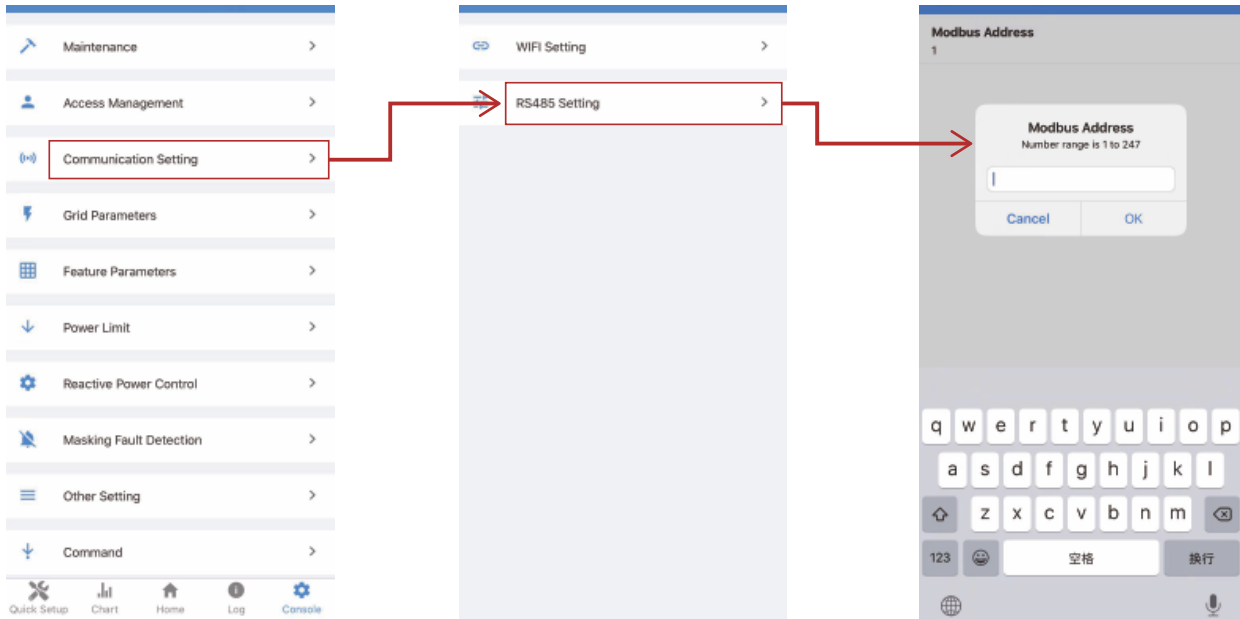
It is mandatory to allow access to every resource the APP needs during installation or setting, in all pop-up windows.

Step 2 Enable bluetooth on your device, open the APP and connect to the inverter. Refer to the QST Manual for this operation.

Step 3 Go to [Console](#) -> [Communication Setting](#) -> [RS485 Setting](#) as shown in the image. In this page, you can set or change the Modbus address if necessary. The default ModBus address is 1, ModBus address can not be identical when one RS485 is wired to multiple inverters.



Please scan the QR code to download the APP



Installation self-check

It is mandatory to verify the inverter installation. This is to avoid electric shock, fire risks, other injuries or faults. Once the inverter has been installed, check the following items:

- Ensure that the inverter is firmly installed.
- Ensure that there is enough space for ventilation.
- Ensure that there is no other object on the PV inverter.
- Ensure that the installation has been made with maintenance in mind.
- Ensure that all screws are tight, especially those used for electrical connections.
- Ensure that every connection is right, including the absence of short-circuits and open circuits.
- Ensure that the waterproof nuts are tight.
- Ensure that the cover plate is properly installed.
- Ensure that every unused connector is covered.
- Ensure that all safety and warning labels are intact and complete.


SYSTEM OPERATION

Inverter first start-up

Step 1 Switch on the AC circuit breaker.

Step 2 Turn on the DC switch on the inverter.

Step 3 Connect to the inverter using the APP *Riello PV* and set the regulations for connecting to the grid, according to local standards and the type of grid that the inverter is connected to. For more information, please refer to the APP user manual.

 NOTE	This setting is required for inverter operation, if it isn't set the inverter doesn't connect to the grid and it will not generate power, even if there is sufficient solar irradiation.
---	--


Step 4 Observe the statuses of the LED indicator lights and the LCD display on the inverter by referring to the table in the user interface chapter.

Powering the inverter on

Step 1 Switch on the AC circuit breaker.

Step 2 Turn on the DC switch on the inverter.

Step 3 Observe the statuses of the LED indicator lights and the LCD display on the inverter by referring to the table in the user interface chapter.


 NOTE	For any queries during the PV inverter's operation, contact your dealer.
---	--

Powering the inverter off

Step 1 Give a shutdown command on the inverter APP.

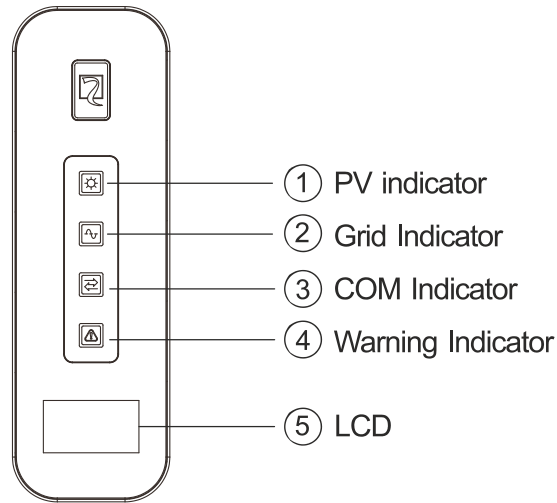
Step 2 Switch off the circuit breaker at the AC terminal.

Step 3 Turn off the DC switch on the inverter.

 WARNING	After the inverter switches off, the remaining electricity and heat may still cause electrical shock and burns. Wait ten minutes after the power-off before servicing the inverter.
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USER INTERFACE

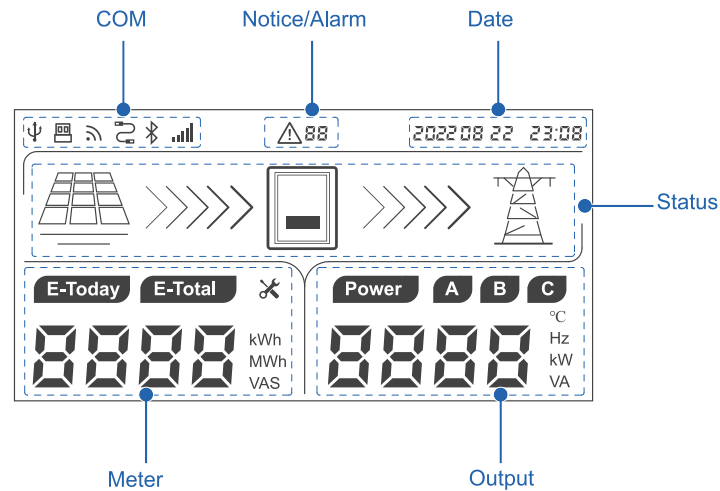
The indicator panel of the inverter is composed of LED indicators and an LCD. The LED indicators include the PV, Grid, COM and Warning indicators.



LED status

LED indicator	State	Description
PV indicator	Fixed	PV String voltage meets the requirements for inverter grid-connecting to generate power.
	Blinking	PV String voltage does not meet the requirements for inverter grid-connecting to generate power.
Grid indicator	Blinking	Grid abnormal, cannot meet the requirements for inverter grid-connecting to generate power.
	Off	Inverter is connected to the grid but is not generating power.
	Fixed	Inverter is connected to the grid and is generating power.
COM indicator	Blinking	Communications data transmission in underway.
	Off	No external communications are connected or no communications data transmission.
Warning indicator	Fixed/blinking	Refer to LED status in warning table.
	Off	No warning.

LCD screen



1) COM

When the inverter is transferring data via Wi-Fi, the icon will be ON, if there is no data transmission, the icon will be off after 10s.

When the inverter is transferring data via RS485, the icon will be ON, if there is no data transmission, the icon will be off after 10s.

2) Warning

When a warning is present on the inverter, the icon will be ON with the specific warning code: the first bit of the code could be A (A)/ B (b)/ C (C), it stands for warning type, and the second bit is warning code, please refer to warning code in “LED/LCD Status and Warning Code Table”.

3) Date

When Wi-Fi / RS485 communications is normal and time zone is set correctly, the built-in clock of inverter will be synchronized with server's time.

4) Status

Icon stands for PV strings; when inverter is in standby status, MPPT voltage of the PV string will be displayed in Meter zone.

Icon stands for grid; when power grid is connected and voltage and frequency are in normal range, the icon is ON, if the voltage and frequency are not ok, the icon blinks; if the power grid is no connected, the icon will be OFF.

Icon stands for energy flow; if the inverter is in normal status, the icon will be on; if the inverter is not feeding the AC output, the icon will be off.

5) Meter

Normal status: in this section, the display shows the “Today” and “Total” energy produced, MPPT voltage and current in sequence.	
Stand-by status: in this section, the display shows the countdown before inverter start-up.	
Any status: in this section, after setting parameter via APP, the screen shows the parameter value (without a comma) for 5 seconds.	

6) Output

Normal status: in this section, the display shows the instantaneous output “Power”, the grid voltage and current for all the three phases and the frequency in sequence.	
--	--

View inverter status

The inverter operation status can be monitored by observing LED indicator status and LCD display. For more details, refer to the table in the following chapter.

View and Set inverter running data


The inverter operation data can be monitored by mobile phone APP.

LED/LCD Status and Warning Code Table

	LCD	PV Indicator	Grid Indicator	COM Indicator	Warning Indicator
Normal status		●	●/★	◎	○
Starting up		●	○	◎	○
WIFI/RS485/LAN communication		◎	◎	★	○
PV normal		●	◎	◎	○
Grid over voltage	A0				
Grid under voltage	A1				
Grid absent	A2				
Grid over frequency	A3	◎	★	◎	○
Grid under frequency	A4				
Grid unbalance	A6				
Grid high average voltage	A7				
PV over voltage	B0				
PV under voltage	B4	★	◎	◎	○
Weak radiation	B5				
Grid neutral abnormal	A8				
Strings abnormal	B3				
Inverter over temperature	C5	◎	◎	◎	★
Fan abnormal	C8				
Insulation resistance abnormal	B1	●	○	○	●
Leakage current abnormal	B2	○	●	○	●
Strings reverse	B7	○	○	●	●
Control power abnormal	C0	○	★	○	●
DC bias current abnormal	C2	★	●	★	●
Inverter relay abnormal	C3	○	●	●	●
Leakage current HCT abnormal	C6	●	●	○	●
System fault	C7	★	★	★	●
DC link voltage unbalance	C9	●	○	●	●
DC link over voltage	CA	○	●	★	●
Internal communication fault	CB	○	○	★	●
Software version incompatibility	CC	★	●	○	●
EEPROM fault	CD	★	○	●	●
Sampling inconsistency	CE	★	●	●	●
Inverter circuit abnormal	CF	●	●	●	●
Boost circuit abnormal	CG	★	○	○	●
Remote off	CN	●	○	◎	○

Note: ● light fixed on ○ light off ★light blinking ◎ keep original status

MAINTENANCE

 WARNING	Before commissioning or performing maintenance on the inverter and its peripheral distribution unit , switch off all the switches and wait at least 10 minutes after the inverter is powered off.
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Check periodically heat sink and the inlet/outlet of fans, clean them, and ensure that they are free from dust and blockage. If there is any abnormality with any of the fans, contact the dealer to request a replacement.

Routine maintenance

Check item	Check content	Maintain content	Maintenance interval
Inverter output status	Statistically maintain the electrical yield status and remotely monitor its abnormal status.	N/A	Weekly
PV inverter cleaning	Periodically check that the heat sink is free from dust and clogging.	Clean the heatsink periodically.	Yearly
PV inverter running status	Check that the inverter is not damaged or deformed. Check for normal sound emissions during inverter operation. Check and ensure that all inverter communications are running well.	If there is any abnormal situation, contact the customer service centre.	Monthly
PV inverter electrical connections	Check that the AC, DC and communication cables are securely connected; check that the PGND cables are securely connected; check that the cables are intact and have no signs of ageing.	If there is any abnormal situation, replace the cable or re-connect it.	Half-yearly

TROUBLESHOOTING


The following table shows inverter's basic common warning and fault handling methods.

Alarm code	Alarm name	Alarm explanation	Measures recommended
A0	Grid over voltage	The grid voltage exceeds the allowed range	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. 3) If the alarm occurs repeatedly for a long time, check whether: <ol style="list-style-type: none"> a. The AC circuit breaker does not open frequently (the instantaneous high pressure). b. The system has been installed according to manual: in case of inappropriate cabling, the cable impedance will cause the power grid to rise. c. The three-phase machine measures whether the voltage between the zero line and the ground line exceeds 30V which is more than the wiring of the grid. <p>If no problem can be detected, contact the customer service centre.</p>
A1	Grid under voltage	The grid voltage exceeds the allowed range	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. 3) If the alarm occurs repeatedly for a long time, check whether: <ol style="list-style-type: none"> a. The AC circuit breaker is not open. b. The AC circuit breaker is not damaged (the input voltage should be consistent with the output voltage). c. The AC terminals are in good contact. <p>If no problem can be detected, contact the customer service centre.</p>
A2	Grid absent	The grid voltage is absent	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. 3) If the alarm occurs repeatedly for a long time, check whether: <ol style="list-style-type: none"> a. The AC circuit breaker is not open. b. The AC circuit breaker is not damaged (the input voltage should be consistent with the output voltage). c. The AC terminals are in good contact. d. The power supply line failure. <p>If no problem can be detected, contact the customer service centre.</p>
A3	Grid over frequency	The grid frequency exceeds the allowed range	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. <p>If no problem can be detected, contact the customer service centre.</p>
A4	Grid under frequency	The grid frequency exceeds the allowed range	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. <p>If no problem can be detected, contact the customer service centre.</p>

Alarm code	Alarm name	Alarm explanation	Measures recommended
A6	Grid abnormal	Three-phase AC grid is abnormal.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2) If the alarm occurs repeatedly, check whether: <ol style="list-style-type: none"> a. The three-phase voltage is measured and confirm the three-phase voltage imbalance is more than 30%. Please improve the power supply condition of the power grid company. b. The AC circuit breaker is working (the voltage of the inlet and the outlet should be consistent). c. All AC lines are working and connected, if any line is interrupted, immediately replace the cable. <p>If no problem can be detected, contact the customer service centre.</p>
B0	PV over voltage	The PV module input voltage is higher than the allowed range.	<ol style="list-style-type: none"> 1) Ensure that the maximum voltage of every single string does not exceed the maximum MPPT voltage. If this is not the case, change the PV string configuration.
B1	PV insulation abnormal	The insulation resistance against the ground is low before inverter start-up.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally and the inverter keeps generating power, it can be caused by an external circuit. The inverter can automatically recover its normal operating status once the fault is solved. 2) If the alarm occurs repeatedly and the inverter cannot generate power reliably, check whether: <ol style="list-style-type: none"> a. The string output cable is connected correctly. b. Any of the PV string cable is damaged. Connect one string at the time to find the problematic string, then replace the damaged connection.
B2	Leakage current abnormal	The insulation resistance against the ground at the input side decreases during inverter operation.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally and the inverter keeps generating power, it can be caused by an external circuit. The inverter can automatically recover its normal operating status once the fault is solved. 2) If the alarm occurs repeatedly and the inverter cannot generate power reliably, check whether: <ol style="list-style-type: none"> a. The string output cable is connected properly. b. If the alarm is accompanied by the insulation impedance alarm, check the insulation to ground. <p>If no problem can be detected, contact the customer service centre.</p>
B4	PV under voltage	The PV module input voltage is lower than the allowed range.	<ol style="list-style-type: none"> 1) If the alarm occurs at some specific situations (low sunlight, bad weather and/or dust storms) the string voltage is lower than normal. No action is needed. 2) If the alarm occurs with good irradiation, check whether the string lines are short-circuited, open-circuited or damaged.
B5	Weak irradiation	The PV module power is less than the minimum inverter operating power.	<ol style="list-style-type: none"> 1) This indicates that the PV modules are not getting enough sunlight. No action is needed.
B7	PV string reverse	The cables of a PV string are connected reversely.	<ol style="list-style-type: none"> 1) Remove all strings and connect them once at the time to find the problematic one. Modify the wrong cable.
C0	Internal power supply abnormal	Inverter internal power source abnormal	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
C2	Inverter over dc-bias current	The DC component current in the grid exceeds the allowed range	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
C3	Inverter relay abnormal	The output relay cannot be closed	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, this could be a grid anomaly. The inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, ensure that the voltage between live and ground/earth are as expected. <p>If no problem can be detected, contact the customer service centre.</p>

Alarm code	Alarm name	Alarm explanation	Measures recommended
C5	Inverter over temperature	Inverter internal temperature high.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, check whether: <ol style="list-style-type: none"> a. The inverter is not under direct sunlight. b. The heat sink is not blocked. c. All fans are working. d. Environment temperature is under 45° C <p>If no problem can be detected, contact the customer service centre.</p>
C6	GFCI abnormal	Residual current test failed during inverter start-up.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally and the inverter keeps generating power, it can be caused by an external circuit. The inverter can automatically recover its normal operating status once the fault is solved. 2) If the alarm occurs repeatedly or for a long period of time, contact the customer service centre.
C7	System type error		<ol style="list-style-type: none"> 1) If this alarm occurs, the inverter cannot operate safely. Try to restart the inverter following the procedure contained in this manual. If restarting the inverter doesn't work, contact the customer service centre.
C8	Fan abnormal	One or more inverter fan is not working properly.	<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, try to restart the inverter. 2) If the alarm occurs repeatedly, one or more fans could be blocked from dust or occlusions. Clean all the fans. 3) If a fan is not spinning at all and is free from blockage, contact the customer service centre to request a substitution. <p>If no problem can be detected, contact the customer service centre.</p>
C9	Unbalance DC-link voltage		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CA	DC-link over voltage		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CB	Internal communication error		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CC	Software incompatibility		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CD	Internal storage error		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CE	Data inconsistency		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CF	Inverter abnormal		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
CG	Boost abnormal		<ol style="list-style-type: none"> 1) If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2) If the alarm occurs repeatedly, contact the customer service centre.
	Remote data monitoring is not updated		<p>If this phenomenon occurs occasionally, it will not be used to display data. If no data gets uploaded for a long time and the inverter is connected to the internet, contact the customer service centre.</p>
	Remote data monitoring shows the inverter icon yellow		<ol style="list-style-type: none"> 1) If the inverter is working, communications are not working at the moment. No action is needed. 2) If the inverter is not working, ensure that the AC breaker is ON.

Alarm code	Alarm name	Alarm explanation	Measures recommended
	All LEDs and the LCD are off in the inverter		1) Ensure that the input voltages are all above 120V. If no problem can be detected, contact the customer service centre.
	Limited energy generation		1) Check the energy meter data and ensure that it is consistent with the monitoring data. 2) Ensure that all components are working properly, including the fans. 3) Check the monitoring data to confirm whether the inverter is free from unchecked alarms.

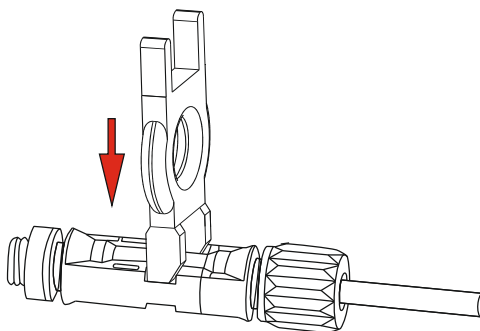
 NOTE	If you cannot clear the preceding alarm according to the recommended measures, contact your dealer promptly.
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Removing the inverter

To remove the inverter, follow the steps below.

Step 1: Turn off the inverter (see dedicated chapter).

Step 2: Remove all cables from the inverter, including any communication cables, DC input, AC output power cables and PGND cables, as shown in the following figure.



 WARNING	Before removing the DC input connector, double-check that the DC input switch is turned OFF to avoid inverter damage and personal injury.
 NOTE	When removing DC input connectors, insert the removal spanner into the bayonet, press the spanner down and take out the connector carefully.

Step 3: Unscrew the fixing screws that fasten the inverter to the rear panel.

Step 4: Remove the inverter from the rear panel.

Step 5: Remove the rear panel.

STORAGE



This chapter describes the storage requirements for the inverter.

The following storage instructions apply if the PV inverter will not be deployed immediately:

- Do not unpack the inverter (add desiccant in the original box if the PV inverter is unpacked).
- Store the PV inverter within a temperature range of -40°C to $+70^{\circ}\text{C}$ and with relative humidity between 0 and 100% (no condensing).
- The PV inverter should be stored in a clean and dry place, protected from dust and water vapour corrosion.
- A maximum of six layers of inverters can be stacked.
- Do not position the inverter tilting frontwards, tilting excessively backwards, tilting sideways or upside-down.
- Conduct periodic inspections during storage.
- Replace the packaging materials immediately if any rodent bites are found.
- Ensure that qualified personnel inspect and test the inverter before use if it has been stored for a long time.

DISPOSING OF THE PRODUCT

Users take the responsibility for the disposal of the inverter.

 WARNING	Dispose the inverter in accordance with relevant local regulations and standards to avoid property losses or casualties.
 NOTICE	Some parts of the inverter may cause environmental pollution. Please dispose of them in accordance with the disposal regulations for electronic waste applicable at the installation site.

APPENDIX

TECHNICAL SPECIFICATIONS

Model	SIRIO-ES 100k	SIRIO-ES 110k
Input (PV)		
Max input voltage	1100V	
Nominal input voltage	600V	
Maximum input current	40A * 3 / 32A * 5	40A * 3 / 32A * 6
Maximum short-circuit current	50A * 3 / 45A * 5	50A * 3 / 45A * 6
Start input voltage	250V	
Minimum operating voltage	200V	
MPPT operating voltage range	200V ~ 1000V	
MPPT operating voltage range (full-load)	540V ~ 800V	
Maximum number of PV strings	16 (2 * 8)	18 (2 * 9)
MPPT inputs	8	9
Output (Grid)		
Rated output power	100kW	110kW
Maximum AC apparent power	111kVA	123kVA
Maximum output current	168.8A	187A
Rated output current	151.9A	167.1A
Maximum short-circuit output current	345A	374A
Rated output voltage	400V/3W + N +PE	
AC voltage range	187V ~ 300V / 322V ~ 520V	
Rated grid frequency	50Hz / 60Hz	
Grid frequency range	45Hz ~ 55Hz / 55Hz ~ 65Hz	
THDi	< 3 % at rated power	
DC current injection	< 0.5 % In	
Adjustable power factor range	> 0.99 at full load (adjustable 0.8LG – 0.8LD)	
Protection		
DC switch	Supported	
Anti-islanding protection	Supported	
AC over current protection	Supported	
AC short circuit protection	Supported	
DC reverse polarity protection	Supported	
Surge arrester	DC Type II ; AC Type II	
Insulation impedance detection	Supported	
Leakage current protection	Supported	
General		
Topology	Transformer-less	
Protection grade	IP66	
Power consumption at night	< 5 W	
Cooling type	Air-cooling	
Operating temperature range	-25° C ~ 60° C (up to 45° C without derating)	
Operating humidity range	0% ~ 100%	
Maximum operating altitude	4000m	
Noise emission	65dB	
Dimensions (W*H*D)	936 mm * 678 mm * 365mm	
Weight	91.5 kg	92 kg



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